This presentation should not be considered a final statement of NIOSH policy or of any agency or individual who was involved. This information is intended for use in advancing knowledge needed to protect workers. Comments regarding this presentation may be submitted to the NIOSH Docket Office.

CBRN Escape Respirator

Laboratory Respirator Protection Level (LRPL) Concept

- Purpose- Establishes a benchmark level of protection under laboratory conditions
- Not intended as an indication of protection for an actual escape scenario

CBRN Escape Respirator

(LRPL) - A Challenging Concept

- Limited data available on fitting hoods based on anthropometric parameters
- Calls for a creation of a new matrix of testing criteria based on anthropometric parameters
- Need review of population distribution statistics of head, neck, face length and width sizes

CBRN Escape Respirator

CBRN Escape LRPL Concept Challenge Aerosol Criteria

- 20 – 40 mg/m^3 Corn Oil
- 0.4 to 0.6 Micrometer Mass Median Aerodynamic Diameter

CBRN Escape Respirator

CBRN Escape LRPL Concept

Options for Sizing

- **Multiple sizes option (S, M, L; S/M, M/L) may allow users to select better fitting hoods and experience fewer user difficulties**
  - 'neck seal too tight'
  - 'unable to fit head through neck seal'
  - 'nosecup won't fit'
  - 'interior head harness won't fit'
- **'One-Size-Fits-All' option also possible**

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CBRN Escape LRPL Concept
Anthropometric Parameters

- Neck Circumference
- Head Circumference
- Face Length
- Face Width *(addition)

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CBRN Escape LRPL Concept

2 LRPL Values

- Breathing Zone (2,000)
- ‘Under the Hood’ (150) *(addition)

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CBRN Escape LRPL Concept

2,000 LRPL in Breathing Zone

- Consistent with current hood technology
- Demonstrated to be achievable in LRPL SBCCOM testing

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LRPL ESCAPE HOOD TESTING AT BREATING ZONE

Hood	# Trials	# Exercises	Pass % at 500	Pass % at 2,000
A	48	10	2.1	0
B	44	10	93.2	86.4
C	46	10	97.8	91.3
D	47	10	97.9	95.7
E	41	8	97.6	90.2
F	40	10	100	82.5

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CBRN Escape LRPL Concept

Rational for 'Under the Hood' LRPL

- Protect user from mild visual effects that may impair escape
  - Percutaneous ECt50 (effective dose)
  - ➢ Slight reduction in vision
  - ➢ Eye injury
  - ➢ Pupils react weakly to light

CBRN Escape Respirator

CBRN Escape LRPL Concept

Determination of 'Under the Hood' LRPL

- Based on Percutaneous Limits for GB
  - LCt50 of 10,000 CT (median lethal dosage)
  - ECt50 of 1,200 CT (mild visual effects)
- 10,000 CT (Outside) ÷ 1,200 CT (Inside) ˜ 15
- 150 LRPL = 15 x 10 (safety factor)

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CBRN Escape LRPL Concept
Rational for Size Ranges

- 'Head Circumference' and 'Neck Circumference'
  - Gordon, C.C., et al. "*1988 Anthropometric Survey of U.S. Army Personnel: Summary Statistics Interim Report*." Technical Report NATICK/TR-89/027. Compiled in DOD *Military Handbook Anthropometry of U.S. Military Personnel.* DOD HDBK-743A.
  - Ranges cover the 5th – 95th percentiles for both men (n = 1774) and women (n = 2,208)

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CBRN Escape LRPL Concept
Rational for Size Ranges (cont.)

- 'Face Length' and 'Face Width'
  - Adapted from Los Alamos panel study. *Selection of Respirator Test Panels Representative of U.S. Adult Facial Sizes.* LA5488. 1974

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CBRN Escape LRPL Concept

Percentiles Ranges of Head and Neck Circumferences (millimeters)*

	5th	50th	95th
Men (neck)	349	379	413
Women (neck)	292	315	343
Men (head)	533	568	594
Women (head)	513	546	571

*Gordon, C.C., et al. (1988)

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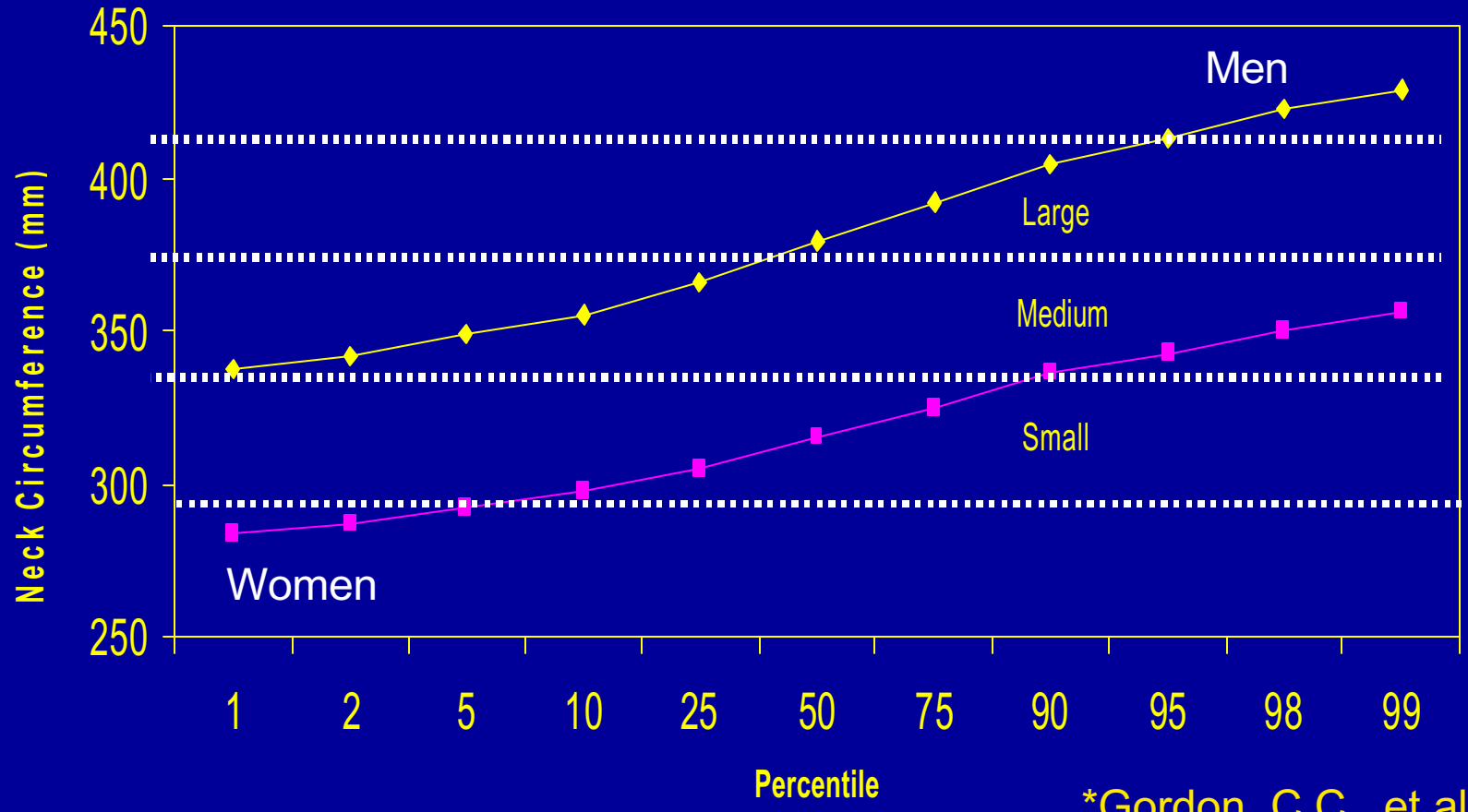
CBRN Escape Respirator

Neck Circumference Population Data*



*Gordon, C.C., et al. (1988)

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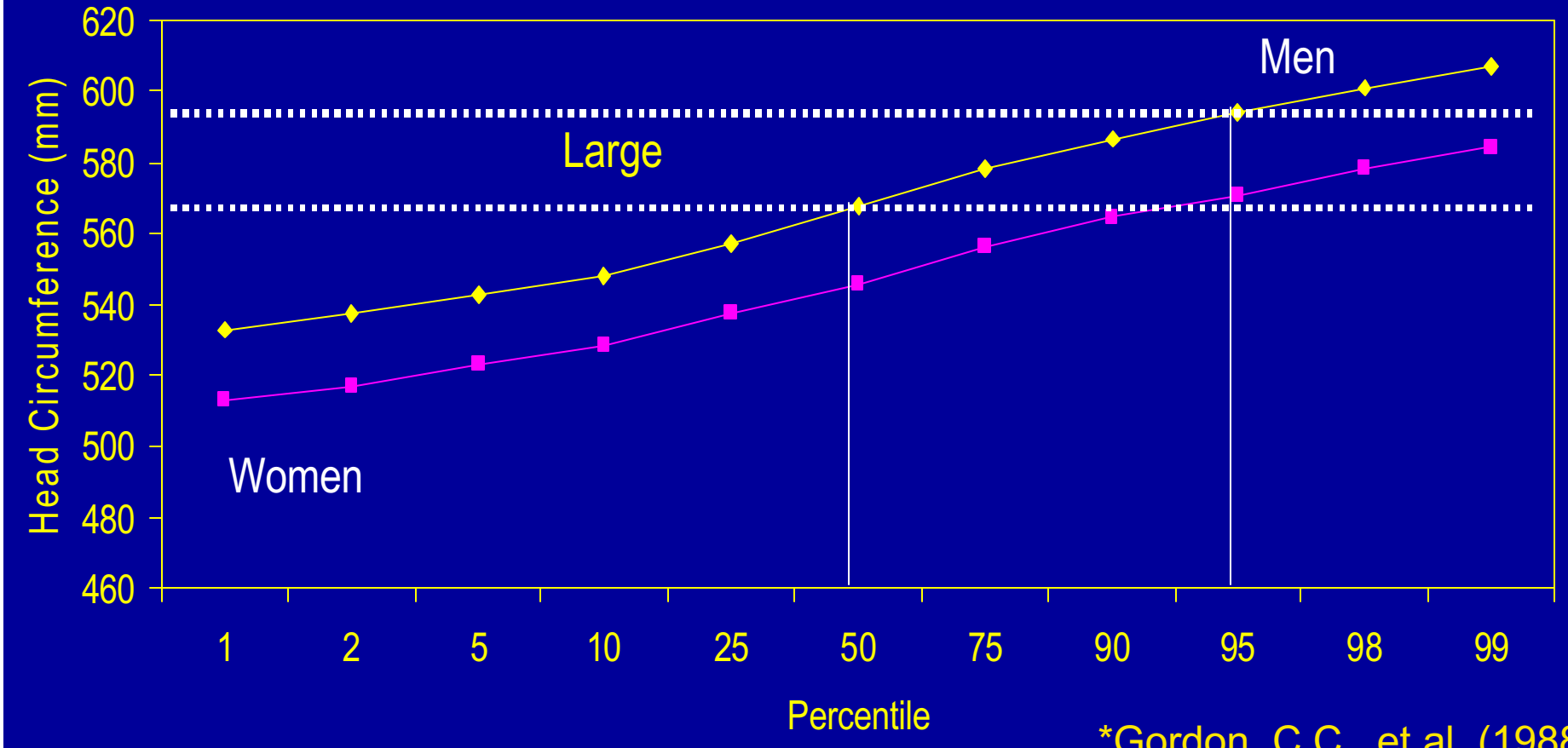
Head Circumference Population Data*



*Gordon, C.C., et al. (1988)

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CBRN Escape Respirator

3 Size Model: Test Each Column Corresponding with Unique Size

'One-Size-Fits-All': Must Meet Criteria of All 3 Size Columns

	Small	Medium	Large
Face Length and Face Width	**Cell A** **Use LANL boxes 1, 2, 3, 4 (2 or 3 subjects each box, 2 trials per subject)** Subjects= 10 Trials= 20	**Cell D** **Use LANL boxes 3, 4, 5, 6, 7, 8; (2 or 3 subjects each box, 2 trials per subject)** Subjects= 17 Trials= 34	**Cell G** **Use LANL boxes 7, 8, 9, 10; (2 or 3 subjects each box, 2 trials per subject)** Subjects= 11 Trials= 22
Head Circumference	Cell B **N / A** Subjects= 0 Trials= 0	Cell E **N / A** Subjects= 0 Trials= 0	Cell H **568*-594 mm** Subjects= 10 Trials= 20
Neck Circumference	Cell C **292-332 mm** Subjects= 10 Trials= 20	Cell F **333-373 mm** Subjects= 10 Trials= 20	Cell I **374-413 mm** Subjects= 10 Trials= 20

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*changed from 569mm in June 15th concept in order to include 50th percentile men

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LRPL Subject Requirement Example

	Large
Face Length and Face Width	**Cell G** **Use LANL boxes 7, 8, 9, 10; panel size 11 (2 or 3 subjects each box, 2 trials per subject)** Subjects= 11 Trials= 22
Head Circumference	**Cell H** **569-594 mm** Subjects= 10 Trials= 20
Neck Circumference	**Cell I** **374-413 mm** Subjects= 10 Trials= 20

Testing a 'Large' Size

If no overlapping

? 31 subjects

If 10 of the 11 subjects in cell G also meet requirements for cell H (but not cell I)

? 21 subjects

(11 for cells G and H plus 10 for cell I)

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CBRN Escape Respirator
LRPL Subject Requirement

Number of Subjects Required for Each Size Respirator

	Small	Medium	Large	One Size Fits All
Minimum	10	17	11	30
Maximum	20	27	31	65